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# ADDITIONAL MEMORANDUM

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## Kerala Floods – 2018

1<sup>st</sup> August to 30<sup>th</sup> August 2018



*Submitted by*

**State Relief Commissioner, Disaster Management  
(Additional Chief Secretary)  
Government of Kerala**

**13-09-2018**

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## 1. Introduction

Kerala is a land of rains and rivers. The State has mainly two rainy seasons viz. the Southwest monsoon that arrives towards the end of May or early June, which is known as *edavapathi* and Northeast season which hits the State during mid-October which is known as *thulam*. The swirling, jostling, billowing monsoon rains was a part of the State every year, however, the Southwest season of 2018 had a different impact as the monsoon resulted in a disastrous flood.

In a span of 30 days, 339 human lives were lost, thousands of houses damaged, over a million and half people were moved to relief camps, large stretches of major roads got washed away and many bridges got damaged. Cochin International Airport which is one of the busiest International airports of the country got flooded and suspended its operations from 15<sup>th</sup> to 29<sup>th</sup> of August 2018. Uninterrupted rains lashed most areas of the State from 8<sup>th</sup> to 18<sup>th</sup> of August 2018 which resulted in wide spread destruction in all the major sectors of the state.

The floods of Southwest season can be comprehended as an evident example of global climate change impact with very heavy rainfall in a short span of time as indicated and predicted by the Fifth Assessment Report published by the Intergovernmental Panel for Climate Change (IPCC) in 2014.

### 1.1. Forecast and preparations

The 1<sup>st</sup> long range forecast (LRF) by India Meteorological Department (IMD) issued on 16<sup>th</sup> April 2018 predicted that the monsoon seasonal rainfall will be 97% of the Long Period Average (LPA) with a model error of  $\pm 5\%$ . Forecast also suggests maximum probability for normal monsoon rainfall (96-104% of LPA) and low probability for deficient rainfall during the season. Based on this forecast, the State Relief Commissioner convened a meeting of all the departmental heads, district collectors, scientific organizations, IMD, Geological Survey of India, National Centre for Earth Science Studies and representatives of defence forces on 16<sup>th</sup> May 2018<sup>1</sup> in which all the stakeholders were assigned specific tasks for better preparedness during the monsoon season. Preparedness at the district level was reviewed by Chief Minister and Minister for Revenue and Disaster Management via video conference on regular intervals and specific instructions were issued regarding the implementation of the decisions of the monsoon preparedness meeting. All districts conducted District Disaster Management Authority meetings to ensure that the decisions of the monsoon preparedness meeting were taken forward for implementation by the respective departments.

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<sup>1</sup> Minutes and circular issued vide Government Letter DM1/217/2018/DMD; dated 28<sup>th</sup> May 2018

Subsequently, IMD issued the 2<sup>nd</sup> stage LRF for the southwest monsoon season on 30<sup>th</sup> May 2018 in which they predicted that the monsoon rainfall will be 95% of LPA over South Peninsula with a model error of  $\pm 8\%$ . It was also predicted that the monthly rainfall over the country as a whole is likely to be 94% of LPA during August both with a model error of  $\pm 9\%$ . It is also indicated in the 2<sup>nd</sup> stage LRF that the forecast probability for 'above normal' rainfall was 13% and 'excess' was only 3%.

It may be noted that in the second stage LRF, predicted value of the total rainfall for the southwest monsoon season was only 95% as against the 97% predicted value in the first stage forecast. So also, the prediction uncertainty band increased from 5% in the first stage to 8% in the second stage. Probability of excess rainfall and above normal rainfall was also predicted to be as low as 3% and 13% respectively. Hence, given the large uncertainty in predictions, the thumb rule to practice is to 'conserve water'.

## 1.2. Monsoon rainfall assessment – 1<sup>st</sup> to 30<sup>th</sup> August 2018

The State received an excess of 96% during the period from 1<sup>st</sup> to 30<sup>th</sup> August 2018, and 33% during the entire monsoon period till the end of August. Table 1 below shows the rainfall excess that the state has received during this period. Note that in the 2<sup>nd</sup> stage forecast issued on 30<sup>th</sup> May 2018, the prediction was only of 95% of LPA (5% less than long period average) during the month of August, while the state received 96% excess rainfall. This unpredicted excess intense rainfall spell have caused significant damage to life and property, the details of which is given in the subsequent chapters.

**Table 1: Monsoon Rainfall Assessment from 1<sup>st</sup> to 30<sup>th</sup> August 2018 (Source: IMD)**

District	Actual Rainfall (mm)	Normal Rainfall (mm)	Percentage Departure (%)	
Thiruvananthapuram	373.8	142	163	Large Excess
Kollam	644.1	258.7	149	Large Excess
Pathanamthitta	764.9	352.7	117	Large Excess
Alappuzha	608.2	343.1	77	Large Excess
Kottayam	619.2	386	60	Large Excess
Idukki	1478.9	527.3	180	Large Excess
Ernakulam	648.3	401.3	62	Large Excess
Thrissur	734.7	440.1	67	Large Excess
Palakkad	848.8	333.8	154	Large Excess
Malappuram	913.7	395.3	131	Large Excess
Kozhikode	836	500.9	67	Large Excess
Wayanad	1053.5	592.9	78	Large Excess
Kannur	665.3	540.9	23	Excess
Kasaragode	636.9	636.3	0	Normal
TOTAL	821	419.3	96	Large Excess

Bureau of Indian Standards IS 4987:1994 prescribes the requirement of 256 rain gauges in the state to be deployed by the nodal agency recognised for the purpose in the country. The State is in receipt of daily rainfall data from 68 rain gauges every 24 hours, which impede the ability of the State to concurrently monitor the spatial distribution and

intensity of rainfall. The station wise monthly rainfall aggregates are given in Table 2. Figure 1, Figure 2 and Figure 3 shows the departure of monthly rainfall in Kerala as compared to the long period average.

### **1.3. Monsoon rainfall assessment – 8<sup>th</sup> to 17<sup>th</sup> August 2018**

The peak spell of rains that created the extreme floods in Kerala occurred between 8<sup>th</sup> to 17<sup>th</sup> of August 2018. The comparison of rainfall prediction and qualitative alerts from IMD as against the realised actual rainfall is given in Table 3. The table clearly indicates that Kerala received rainfall which was completely unprecedented. It may be seen that, while on 8<sup>th</sup> August, the expectation was to receive heavy to very heavy rainfall in most districts of the state, but it exceeded and the state received extremely heavy rainfall in Idukki and Wayand.

On 09-08-18, while there was no significant alert requiring actions the actual daily rainfall received in the district was heavy to very heavy rainfall in 7 districts (Idukki, Wayanad, Kozhikkode, Malappuram, Palakkad, Kottayam and Pathanamthitta). Similarly on 10<sup>th</sup>, 11<sup>th</sup> and 12<sup>th</sup> of August, while red alert was issued for 5 to 8 districts, the actual rainfall there was only very light to light.

On the next more crucial day, August 15<sup>th</sup>, the prediction was mostly for yellow in the State with four districts to be receiving red and one receiving orange, the entire state received extremely heavy rainfall. On 16<sup>th</sup> August, 7 districts were predicted to be receiving orange and 7 to be receiving red, the actual rainfall received was yellow in three, one green, one orange and 9 red. Thus the actual rainfall received in the state exceeded predicted rainfall in most crucial days on which the state was flooded. Graphical representations and maps that indicate spatial comparison between predicted rainfall and actual rainfall can be found in the Annexures. While comparing the available district wise daily rainfall forecast with actual realised rainfall, it can be ascertained that there is a wide disparity between the predicted amount of rainfall and the actual received. Thus, it is evident that the actual rainfall received significantly exceeded the expectation. This unforeseen exceedance and high intensity of rainfall resulted in tremendous overland flow leading to complete saturation of top soil, caused deep seated landslides, debris flows and substantial sheet erosion resulting in the rivers exceeding the levee areas and causing destruction to life and property.

The Central Water Commission, in its report on Kerala Floods 2018 states that “it can be seen that the 2-day and 3-day rainfall depths of 15-17, August 2018 rainfall in Pamba, Periyar and Bharathapuzha sub-basins are most comparable to the Devikulam storm of 16-18, July 1924. For the entire Kerala the depth of rainfall realised during 15-17, August 2018 is 414 mm, while the same during 16-18, July 1924 was 443 mm”.



**Table 2: Station wise monthly rainfall for the months of June, July and August 2018 (Source: IMD)**

Sl.No	District	Station Name	Jun-18				Jul-18				Aug-18			
			Actual Rainfall (mm)	Normal Rainfall (mm)	Departure (%)		Actual Rainfall (mm)	Normal Rainfall (mm)	Departure (%)		Actual Rainfall (mm)	Normal Rainfall (mm)	Departure (%)	
1	Thiruvananthapuram	Trv City	397.6	338.7	17.39	Normal	218.4	228.9	-4.59	Normal	322.8	142	127.3	Large Excess
2		Trv AP	420.5	338.7	24.15	Excess	234.21	228.9	2.32	Normal	255	142	79.58	Large Excess
3		Nedumangad	362	338.7	6.88	Normal	250.2	228.9	9.31	Normal	259.4	142	82.68	Large Excess
4		Neyyattinkara	280	338.7	-17.33	Normal	239.8	228.9	4.76	Normal	242	142	70.42	Large Excess
5		Varkala	308.8	338.7	-8.83	Normal	193.6	228.9	-15.42	Normal	266.1	142	87.39	Large Excess
6	Kollam	Kollam	277.6	457.7	-39.35	Deficient	372.8	398	-6.33	Normal	372	258.7	43.8	Excess
7		Aryankavu	404.2	457.7	-11.69	Normal	335	398	-15.83	Normal	509	258.7	96.75	Large Excess
8		Punalur	414.8	457.7	-9.37	Normal	511.5	398	28.52	Excess	526.4	258.7	103.5	Large Excess
9	Pathanamthitta	Konni	565.5	556.9	1.54	Normal	679.4	539.9	25.84	Excess	689	352.7	95.35	Large Excess
10		Kurudamannil	453.5	556.9	-18.57	Normal	490.2	539.9	-9.21	Normal	612.4	352.7	73.63	Large Excess
11	Alappuzha	Alappuzha	757.8	593	27.79	Excess	695.9	533	30.56	Excess	477.6	343.1	39.2	Excess
12		Kayamkulam	578.2	593	-2.5	Normal	542.4	533	1.76	Normal	346.2	343.1	0.9	Normal
13		Mavelikkara	511.7	593	-13.71	Normal	625.6	533	17.37	Normal	614	343.1	78.96	Large Excess
14		Cherthala	729.6	593	23.04	Excess	782.2	533	46.75	Excess	353.6	343.1	3.06	Normal
15		Mancompu	464.2	593	-21.72	Deficient	789.3	533	48.09	Excess	337.8	343.1	-1.54	Normal
16		Haripad	419.2	593	-29.31	Deficient	596.2	533	11.86	Normal	346.8	343.1	1.08	Normal
17		Chengannur	429.8	593	-27.52	Deficient	672	533	26.08	Excess	358	343.1	4.34	Normal
18		CPCRI Kayamkulam	378.8	593	-36.12	Deficient	325.1	533	-39.01	Deficient	211.3	343.1	-38.41	Deficient
19	Kottayam	Kottayam	656.3	649.1	1.11	Normal	803.2	591.4	35.81	Excess	504.4	386	30.67	Excess
20		Vaikom	1274.7	649.1	96.38	Large Excess	1017	591.4	71.96	Large Excess	484.3	386	25.47	Excess
21		Kumarakom	331.8	649.1	-48.88	Deficient	622.1	591.4	5.19	Normal	270.7	386	-29.87	Deficient
22		Kozha	368.9	649.1	-43.17	Deficient	499.6	591.4	-15.52	Normal	390.2	386	1.09	Normal
23	Idukki	Peermade	1207	651.6	85.24	Large Excess	1419.3	788.9	79.91	Large Excess	1522.7	527.3	188.8	Large Excess
24		Thodupuzha	760.8	651.6	16.76	Normal	1180.1	788.9	49.59	Excess	785.7	527.3	49	Excess
25		Munnar	700.3	651.6	7.47	Normal	1437.6	788.9	82.23	Large Excess	1489.7	527.3	182.5	Large Excess
26		Idukki	815.3	651.6	25.12	Excess	1460.2	788.9	85.09	Large Excess	1159.6	527.3	119.9	Large Excess
27		Myladumpara	504	651.6	-22.65	Deficient	775.6	788.9	-1.69	Normal	911.6	527.3	72.88	Large Excess
28	Emakulam	Kochi AP	727.6	696.4	4.48	Normal	956.51	670.2	42.72	Excess	410.8	401.3	2.37	Normal
29		Aluva	680.7	696.4	-2.25	Normal	803.4	670.2	19.87	Normal	374.4	401.3	-6.7	Normal
30		Piravom	1178.1	696.4	69.17	Large Excess	1601	670.2	138.88	Large Excess	720.2	401.3	79.47	Large Excess

31	Ernakulam	Perumbavur	831.2	696.4	19.36	Normal	968.7	670.2	44.54	Excess	664.4	401.3	65.56	Large Excess
32		CIAL Kochi	764	696.4	9.71	Normal	956.8	670.2	42.76	Excess	146.4	401.3	-63.52	Large Deficient
33		Ernakulam South	NA	696.4	NA	NA	44	670.2	-93.43	Large Deficient	377	401.3	-6.06	Normal
34	Thrissur	Kodungallur	636.1	707.4	-10.08	Normal	825.6	772.9	6.82	Normal	298.2	440.1	-32.24	Deficient
35		Irinjalakuda	619.1	707.4	-12.48	Normal	657.1	772.9	-14.98	Normal	552.6	440.1	25.56	Excess
36		Vadakkancherry	635.8	707.4	-10.12	Normal	677.2	772.9	-12.38	Normal	620.8	440.1	41.06	Excess
37		Kunnamkulam	370.4	707.4	-47.64	Deficient	389.4	772.9	-49.62	Deficient	549.6	440.1	24.88	Excess
38		Chalakydy	591	707.4	-16.45	Normal	716.6	772.9	-7.28	Normal	492.6	440.1	11.93	Normal
39		Enamackel	351.6	707.4	-50.3	Deficient	584	772.9	-24.44	Deficient	324.2	440.1	-26.33	Deficient
40		Vellanikkara	729.8	707.4	3.17	Normal	829.21	772.9	7.29	Normal	773.3	440.1	75.71	Large Excess
41	Palakkad	Palakkad	620.8	464.3	33.71	Excess	926.9	595.4	55.68	Excess	949.32	333.8	184.4	Large Excess
42		Mannarkad	761.8	464.3	64.07	Large Excess	861.6	595.4	44.71	Excess	824.2	333.8	146.9	Large Excess
43		Ottappalam	999.8	464.3	115.33	Large Excess	1064	595.4	78.7	Large Excess	809.6	333.8	142.5	Large Excess
44		Alathur	558.4	464.3	20.27	Excess	638.3	595.4	7.21	Normal	814.4	333.8	144	Large Excess
45		Chittur	400.1	464.3	-13.83	Normal	844	595.4	41.75	Excess	571.5	333.8	71.21	Large Excess
46		Kollengode	443.6	464.3	-4.46	Normal	611.8	595.4	2.75	Normal	675.4	333.8	102.3	Large Excess
47		Pattambi	783.6	464.3	68.77	Large Excess	693.9	595.4	16.54	Normal	538.8	333.8	61.41	Large Excess
48		Thrithala	601.6	464.3	29.57	Excess	591.9	595.4	-0.59	Normal	499.6	333.8	49.67	Excess
49		Parambikulam	581	464.3	25.13	Excess	563	595.4	-5.44	Normal	484	333.8	45	Excess
50	Malappuram	Nilambur	757.6	660.9	14.63	Normal	900.8	792.9	13.61	Normal	1080	395.3	173.2	Large Excess
51		Manjeri	735.3	660.9	11.26	Normal	934.8	792.9	17.9	Normal	628.3	395.3	58.94	Excess
52		Perinthalmanna	849.8	660.9	28.58	Excess	947.9	792.9	19.55	Normal	674.4	395.3	70.6	Large Excess
53		Ponnani	824.9	660.9	24.81	Excess	608.8	792.9	-23.22	Deficient	593	395.3	50.01	Excess
54		Angadippuram	574.3	660.9	-13.1	Normal	775.6	792.9	-2.18	Normal	518.6	395.3	31.19	Excess
55		Karipur AP	872.51	660.9	32.02	Excess	855.01	792.9	7.83	Normal	552.5	395.3	39.77	Excess
56	Wayanad	Mananthavady	825.8	698.1	18.29	Normal	1113.5	1110.4	0.28	Normal	1194.6	592.9	101.5	Large Excess
57		Vythiri	1380.5	698.1	97.75	Large Excess	1377.7	1110.4	24.07	Excess	732.4	592.9	23.53	Excess
58		Ambalavayal	343.7	698.1	-50.77	Deficient	786	1110.4	-29.21	Deficient	624.6	592.9	5.35	Normal
59	Kuppady	441.6	698.1	-36.74	Deficient	694.8	1110.4	-37.43	Deficient	658.5	592.9	11.06	Normal	
60	Kozhikode	Kozhikode	781.1	895.8	-12.8	Normal	806	955.2	-15.62	Normal	517.2	500.9	3.25	Normal
61		Vadakara	1514.1	895.8	69.02	Large Excess	1392.9	955.2	45.82	Excess	873.4	500.9	74.37	Large Excess
62		Quilandy	891	895.8	-0.54	Normal	494	955.2	-48.28	Deficient	552	500.9	10.2	Normal
63	Kannur	Kannur	878.8	852.4	3.1	Normal	816.1	1055	-22.64	Deficient	428.3	540.9	-20.82	Deficient
64		Taliparamba	857.7	852.4	0.62	Normal	897.4	1055	-14.94	Normal	542	540.9	0.2	Normal
65		Thalasserry	895.3	852.4	5.03	Normal	780.2	1055	-26.05	Deficient	402.8	540.9	-25.53	Deficient
66		Irikkur	1171	852.4	37.38	Excess	1117	1055	5.88	Normal	677	540.9	25.16	Excess
67	Kasargod	Hosdurg	875.4	999.6	-12.42	Normal	826.7	1108.5	-25.42	Deficient	592.7	636.3	-6.85	Normal
68		Kudulu	1039	999.6	3.94	Normal	713.4	1108.5	-35.64	Deficient	441.6	636.3	-30.6	Deficient

**Table 3: District wise qualitative prediction and comparison with realisation (Source: IMD)**

DISTRICTS	DISTRICT WISE DAILY RAINFALL FORECAST (24 HR PRIOR FORECAST FOR EACH DAY) FROM 08.08.18 TO 22.08.18 (SOURCE: IMD)															
	08.08.18	09.08.18	10.08.18	11.08.18	12.08.18	13.08.18	14.08.18	15.08.18	16.08.18	17.08.18	18.08.18	19.08.18	20.08.18	21.08.18	22.08.18	
Thiruvananthapuram	Yellow	Green	Yellow	Green	Green	Green	Green	Yellow	Orange	Yellow	Green	Green	Green	Green	Green	
Kollam	Yellow	Green	Yellow	Yellow	Yellow	Green	Green	Yellow	Orange	Orange	Yellow	Green	Green	Green	Green	
Pathanamthitta	Yellow	Yellow	Yellow	Orange	Yellow	Orange	Yellow	Yellow	Orange	Red	Yellow	Yellow	Green	Green	Green	
Alappuzha	Orange	Yellow	Yellow	Red	Red	Orange	Orange	Orange	Orange	Orange	Yellow	Yellow	Green	Green	Green	
Kottayam	Orange	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Orange	Orange	Yellow	Yellow	Green	Green	Green	
Ernakulam	Orange	Yellow	Yellow	Red	Red	Orange	Orange	Orange	Red	Red	Red	Yellow	Green	Green	Green	
Idukki	Orange	Yellow	Red	Red	Red	Red	Red	Red	Red	Red	Red	Yellow	Green	Green	Green	
Thrissur	Orange	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Orange	Red	Yellow	Yellow	Green	Green	Green	
Palakkad	Orange	Yellow	Red	Red	Red	Orange	Yellow	Yellow	Red	Red	Yellow	Yellow	Green	Green	Green	
Malappuram	Orange	Yellow	Orange	Red	Red	Orange	Yellow	Yellow	Red	Red	Yellow	Yellow	Green	Green	Green	
Kozhikkode	Orange	Yellow	Red	Red	Red	Orange	Yellow	Yellow	Red	Red	Yellow	Yellow	Green	Green	Green	
Wayanad	Orange	Yellow	Red	Red	Red	Red	Red	Red	Red	Red	Yellow	Yellow	Green	Green	Green	
Kannur	Orange	Yellow	Red	Red	Red	Orange	Yellow	Red	Red	Red	Yellow	Green	Green	Green	Green	
Kasaragod	Orange	Yellow	Yellow	Yellow	Orange	Yellow	Yellow	Red	Orange	Yellow	Green	Green	Green	Green	Green	
DISTRICTS	ACTUAL REALISED RAINFALL FROM 08.08.18 TO 22.08.18 (SOURCE: IMD DAILY RAINFALL ARCHIVE MAPS)															
	08.08.18	09.08.18	10.08.18	11.08.18	12.08.18	13.08.18	14.08.18	15.08.18	16.08.18	17.08.18	18.08.18	19.08.18	20.08.18	21.08.18	22.08.18	
Thiruvananthapuram	Green	Green	Green	Green	Green	Green	Green	Red	Yellow	Green	Green	Green	Green	Green	Green	
Kollam	Yellow	Yellow	Yellow	Green	Green	Green	Green	Red	Yellow	Yellow	Yellow	Green	Green	Green	Green	
Pathanamthitta	Yellow	Red	Yellow	Green	Green	Yellow	Orange	Red	Red	Red	Orange	Green	Green	Green	Green	
Alappuzha	Yellow	Yellow	Green	Green	Green	Green	Green	Red	Red	Yellow	Green	Green	Green	Green	Green	
Kottayam	Orange	Red	Orange	Green	Green	Green	Yellow	Red	Red	Red	Orange	Green	Green	Green	Green	
Ernakulam	Yellow	Yellow	Green	Green	Green	Yellow	Green	Red	Red	Orange	Green	Green	Green	Green	Green	
Idukki	Red	Red	Red	Yellow	Green	Orange	Orange	Red	Red	Red	Red	Orange	Green	Green	Green	
Thrissur	Orange	Green	Green	Green	Green	Green	Green	Red	Red	Red	Green	Green	Green	Green	Green	
Palakkad	Yellow	Red	Yellow	Green	Green	Yellow	Orange	Red	Red	Orange	Yellow	Green	Green	Green	Green	
Malappuram	Orange	Red	Yellow	Green	Green	Yellow	Orange	Red	Red	Yellow	Orange	Green	Green	Green	Green	
Kozhikkode	Orange	Red	Green	Green	Green	Yellow	Orange	Red	Red	Yellow	Green	Green	Green	Green	Green	
Wayanad	Red	Red	Yellow	Green	Green	Yellow	Orange	Red	Orange	Orange	Yellow	Green	Green	Green	Green	
Kannur	Orange	Orange	Green	Green	Green	Yellow	Yellow	Red	Yellow	Yellow	Green	Green	Green	Green	Green	
Kasaragod	Green	Green	Green	Green	Green	Yellow	Orange	Red	Green	Yellow	Green	Green	Green	Green	Green	

COLOUR CODE		RAINFALL INTENSITY (MM)	
Green	NO WARNING (No Action)	Light to Moderate at Isolated places	Light (2.5-15.5mm)
Yellow	WATCH (Be Updated)	Heavy Rainfall at Isolated Places	Moderate (15.6-64.4mm)
Orange	ALERT (Be Prepared)	Heavy to Very Heavy Rainfall at Isolated Places	Heavy (64.5-115.5mm)
Red	WARNING (Take Action)	Heavy to Very Heavy Rainfall at few Places	Very Heavy (115.6-204.4mm)
			Extremely Heavy (> 204.5mm)

*Note: Daily Rainfall Forecast issued at 13:00 hrs of each day was considered as the rainfall prediction for the next day (On 13-08-18 modified rainfall forecast received at 2000hrs was considered as the prediction for 14-08-18)*

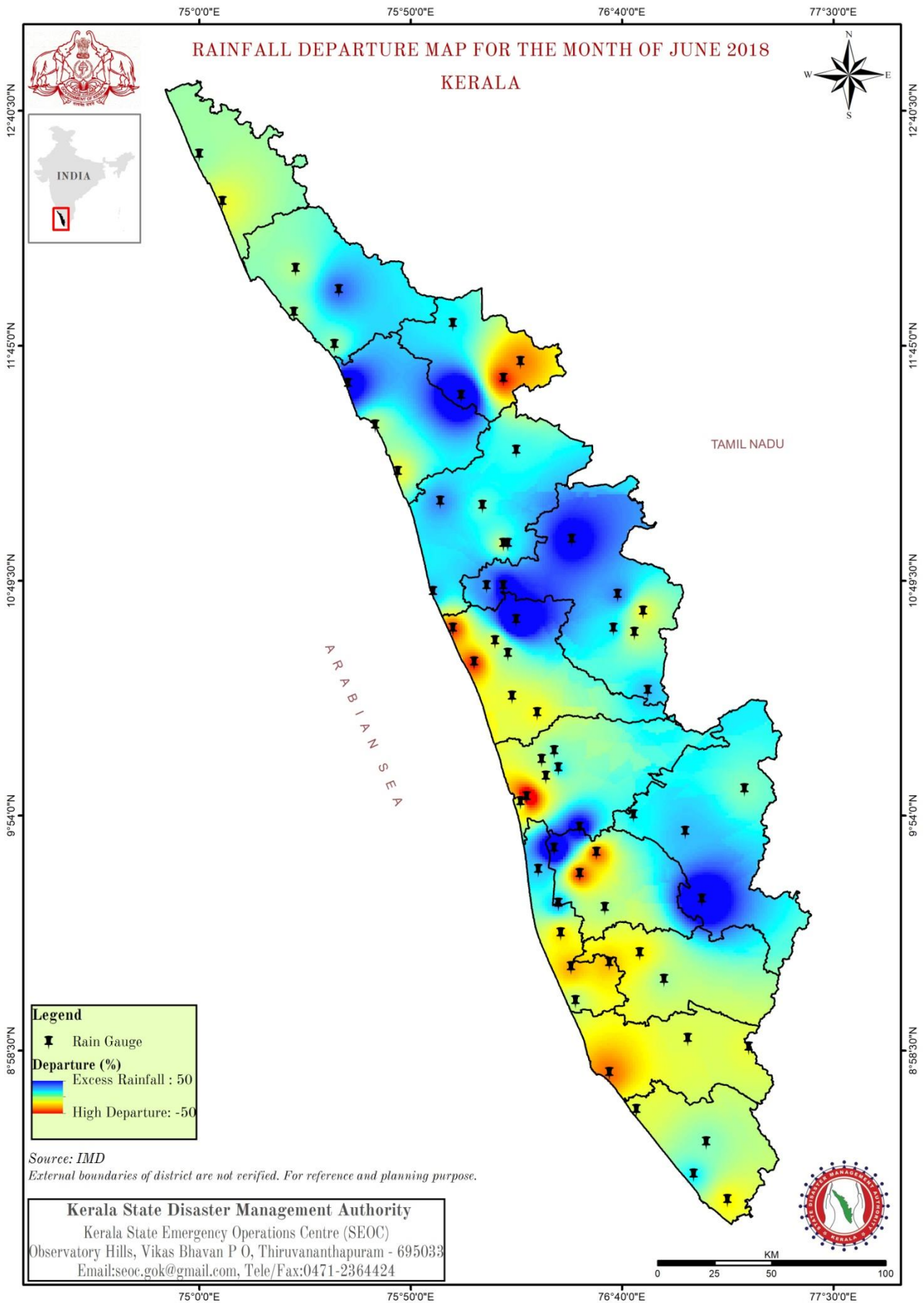
#### 1.4. Flooding – 8<sup>th</sup> to 22<sup>nd</sup> August 2018

The intense unprecedented spell of rainfall began on 8<sup>th</sup> August 2018. The rainfall initially was active in the northern districts of Kerala causing widespread flooding in Wayanad, Kannur and Mallappuram. Rainfall of 398 mm which is equivalent to one day Standard Project Storm was experienced in Nilambur of Malappuram district on 9-08-2018. The rainfall was intense in these districts on 8<sup>th</sup> and 9<sup>th</sup> August. On contrary to the predictions, after a relatively low spell of rainfall from 10<sup>th</sup> to 13<sup>th</sup> August, the precipitation increased substantially over the entire state attaining its peak on 15<sup>th</sup>, 16<sup>th</sup> and 17<sup>th</sup> August. This rain spell was wide spread and affected the entire state as it is evident from Table 3.

The Hydrological Studies Organisation of Central Water Commission of Government of India submitted a detailed report titled ‘Study report – Kerala Floods of August 2018’ on September 2018. This report states that, the actual rainfall from 15<sup>th</sup> to 17<sup>th</sup> August in the State was 414 mm as compared to the extreme rainfall from 16<sup>th</sup> to 18<sup>th</sup> July 1924 during which it was 443 mm. This generated around 12 Billion Cubic Meter runoff within these three days, which is just about 3% lesser runoff than in 1924.

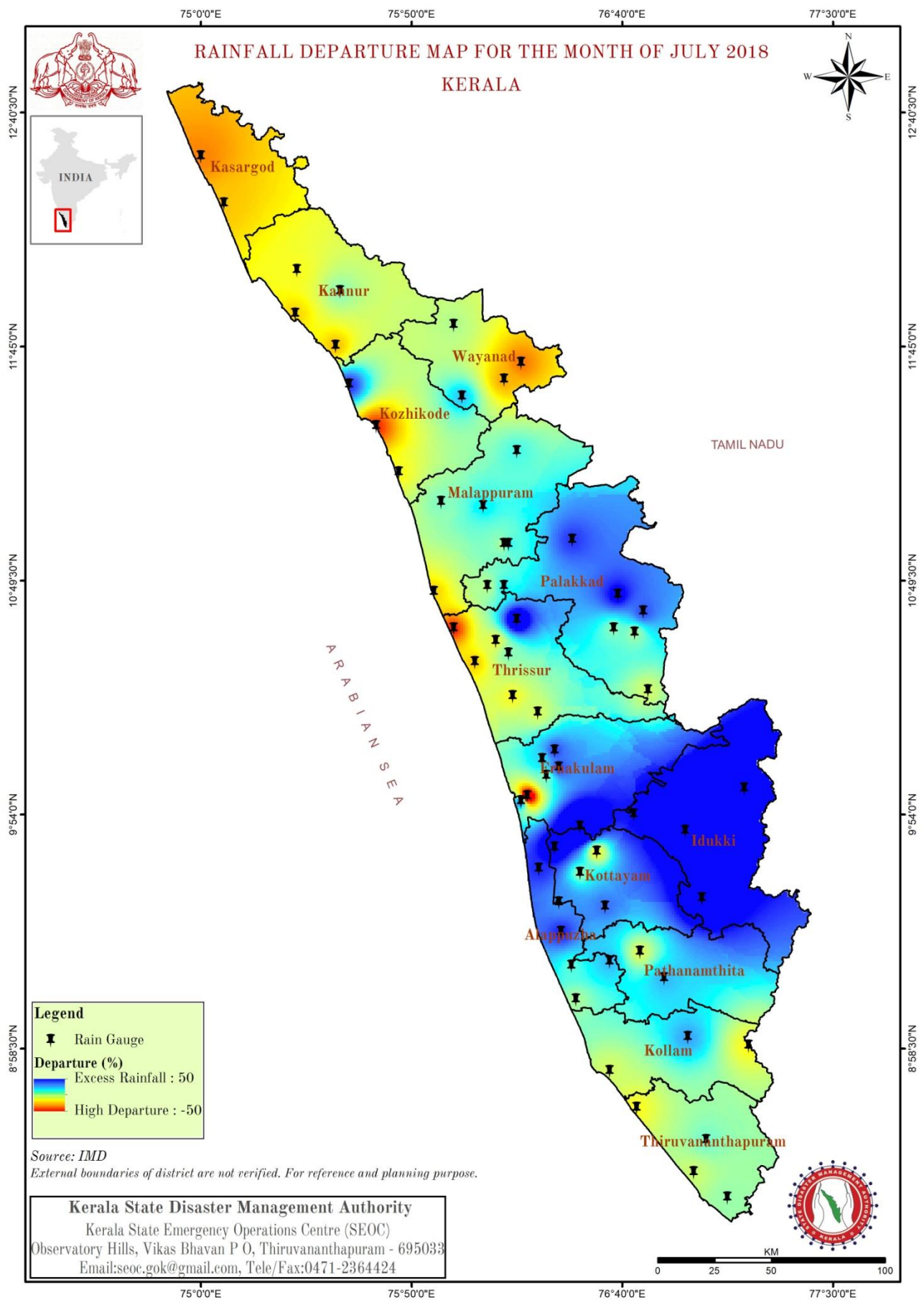
The severity of flood was increased by high tide due to perigean spring tides for the period of 11<sup>th</sup> to 15<sup>th</sup>, August 2018. The Spring Tides raised the low tide water levels substantially and thus, outflow of flood water into sea was substantially impeded.

According to the satellite image analysis based flood affected area maps provided by National Remote Sensing Centre (NRSC), between 16-07-2018 to 28<sup>th</sup> August 2018, 65,188 hectares of land area was inundated. Many areas were under water for more than 2 weeks. Densely populated Kuttanad backwater belt of Alappuzha was under water since July 2018 as polder walls (bund) breached. Figure 4 shows the flood affected areas between 16<sup>th</sup> July and 28<sup>th</sup> August, plotted against the flood prone areas of Kerala. The flood prone area map was prepared as a worst case scenario by National Centre for Earth Science Studies (NCESS) and legalised in the Kerala State Disaster Management Plan 2016.

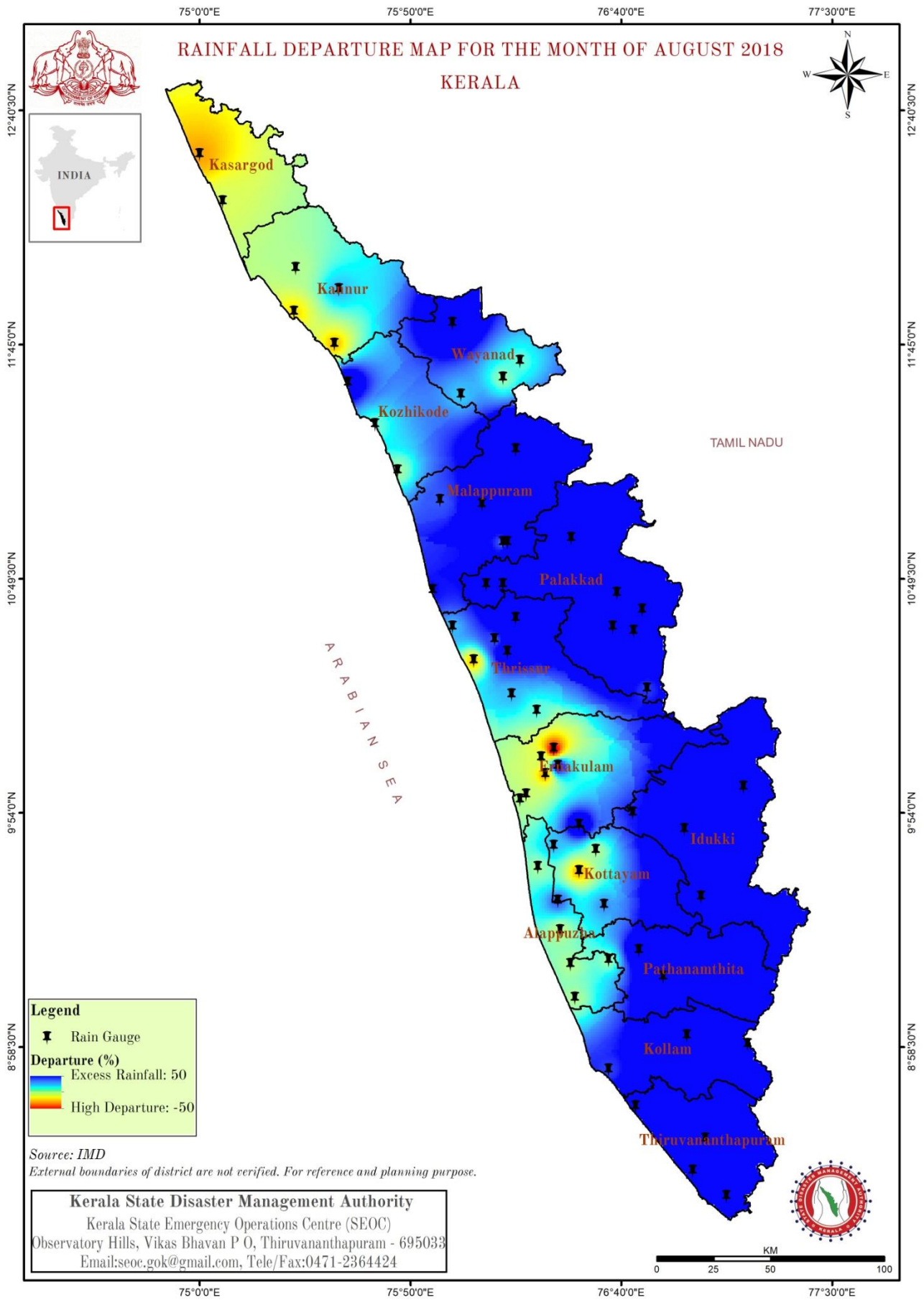


**Figure 1: Rainfall departure for the month of June 2018 (Data source: IMD)**

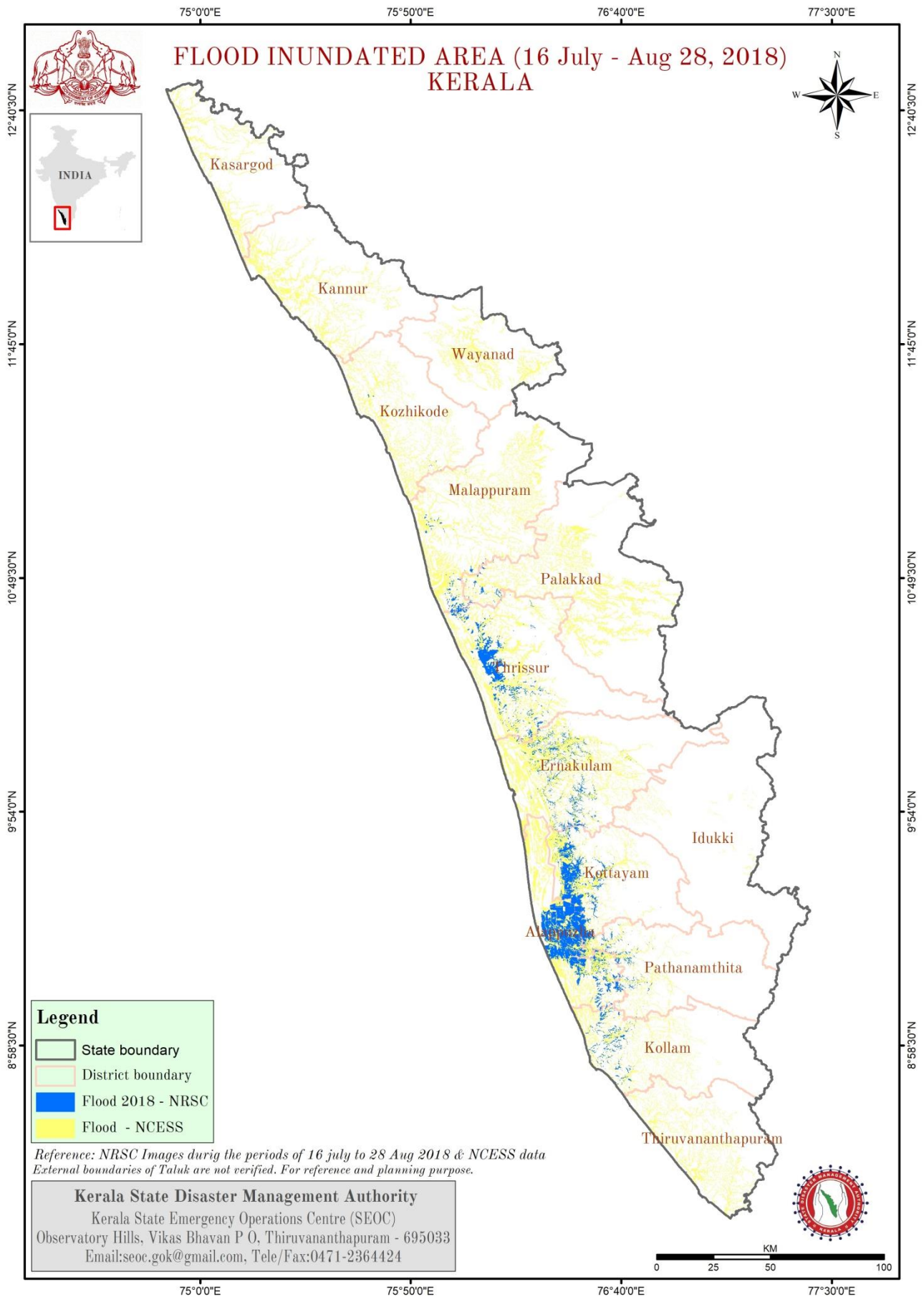




**Figure 2: Rainfall departure for the month of July 2018 (Data source: IMD)**



**Figure 3: Rainfall departure for the month of August 2018 (Data source: IMD)**



**Figure 4: Flood affected areas as derived from Radar Images plotted against the flood prone areas of Kerala**



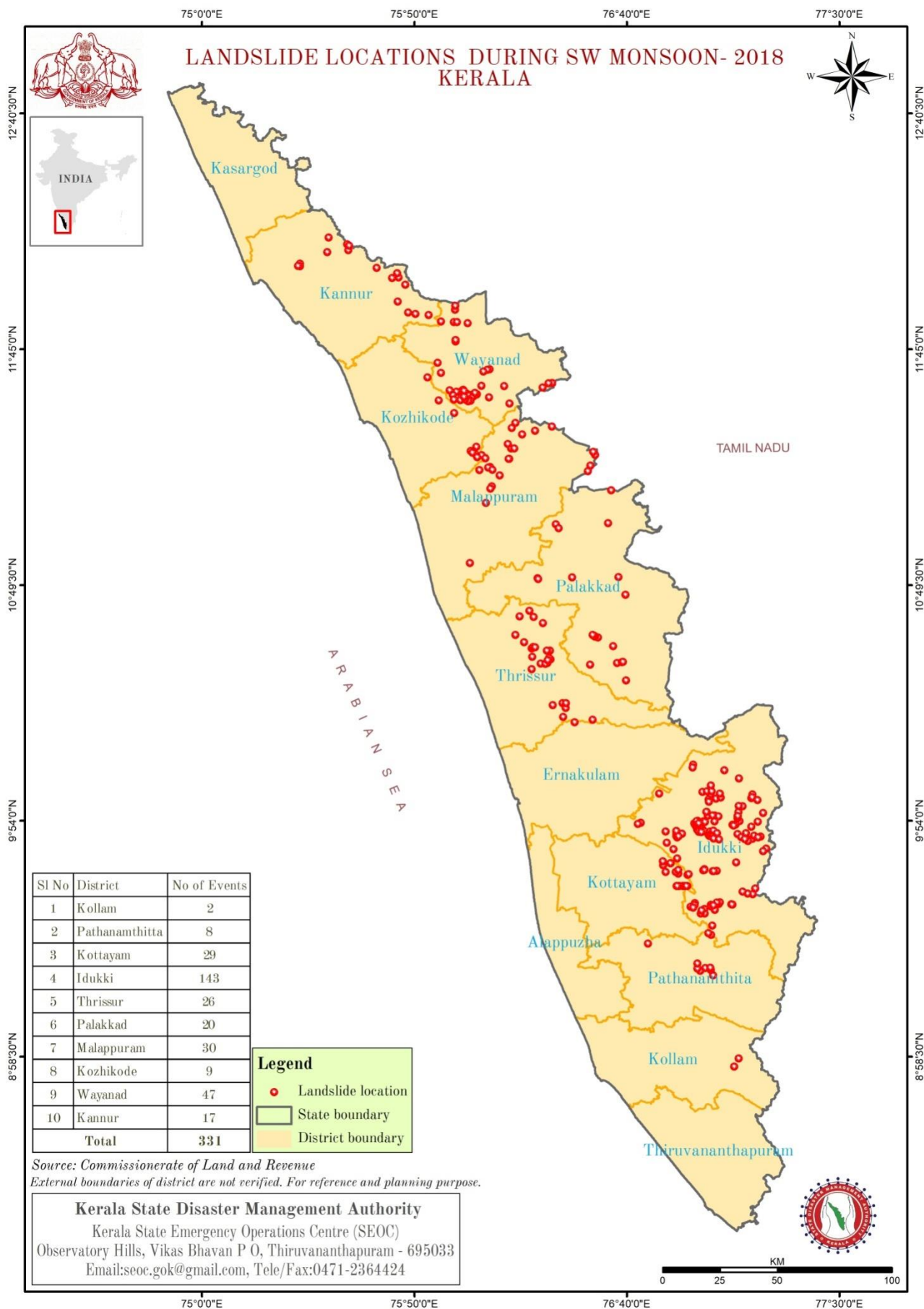
## **1.5. Landslides – August 2018**

Kerala is prone to landslides. The Kerala State Disaster Management Plan identifies 14.4% of the State as landslide prone. The Land Revenue Department reported 331 landslides that have occurred in Revenue land. In the month of August, 104 individuals have lost their lives in landslides in the State. Numerous landslides are reported to have occurred inside.

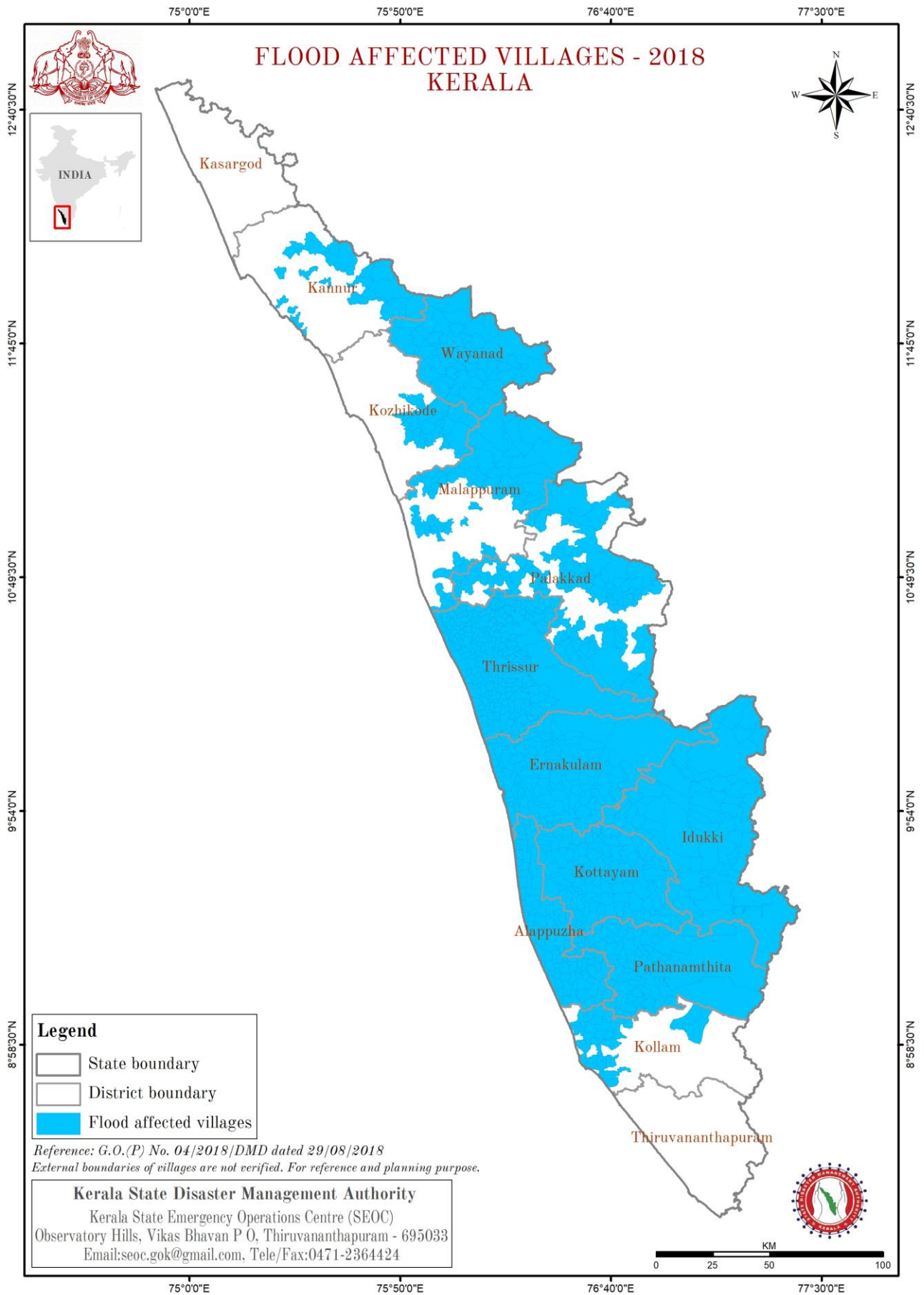
Historically, landslides of Kerala are of debris flow type and confined to certain catchments. However, in this unpredicted and unprecedented rainfall, there were numerous deep seated landslides, rock slides and landslips. Figure 5 shows the locations of 331 landslides that occurred in Revenue land in the state.

## **1.6. Action taken report**

A timeline of action taken in light of the monsoon is given in Annexure.



**Figure 5: Locations of landslides that occurred in August 2018**



**Figure 6: First stage flood notification**

## 2. Assessment of relief as per SDRF norms

### 2.1 Human Fatalities

Three hundred and thirty nine (339) lives were lost during the period of this memorandum due to landslides, floods etc. Table 4 shows the district wise human fatalities reported. Thrissur district has lost the maximum lives which is 72.

**Table 4: Human Fatality (Source: Daily report from Commissionerate of Land Revenue)**

District	Fatalities	Total @ ₹4 lakhs
Thiruvananthapuram	11	44
Kollam	5	20
Pathanamthitta	3	12
Alappuzha	43	172
Kottayam	14	56
Idukki	54	216
Ernakulam	58	232
Thrissur	72	288
Palakkad	20	80
Malappuram	30	120
Kozhikode	16	64
Wayanad	6	24
Kannur	6	24
Kasaragode	1	4
<b>Total</b>	<b>339</b>	<b>1356</b>

### 2.2 Agriculture

The total geographic area of the State is 3,88,6287 ha. The net area under cultivation during the year 2017-18 was 20,48,109 ha, which occupies 52.7% of the total area in the State. Agricultural crops in the state are broadly classified as food crops and non-food crops. Food crops are cereals, millets, sugar crops, spices and condiments, fresh fruits, vegetables, etc. The major non-food crops are rubber, betel leaves, lemon grass, etc. Another classification of crop is seasonal crops, annual crops and perennial crops which are based on their life time.

- Seasonal crops: Paddy, pulses, tapioca, vegetables, sweet potato, tubers, groundnut, ginger, turmeric, cotton, tobacco, onion, tur etc.
- Annual crops: Sugarcane, banana, plantain, pineapple, betel leaves, etc.
- Perennial crops: Coconut, arecanut, cashew, mango, jack, tamarind, pepper, rubber, tea, coffee, cardamom, cloves, nutmeg, cinnamon, cocoa, papaya, etc.

#### 2.3.1 Statistics of Agriculture

- Total cropped area - 25,84,007.198 ha
- Net area sown - 20,15,482 ha
- Area sown more than once - 5,68,525.198 ha
- Net area irrigated (source wise) - 377761 ha

- Net area irrigated (source wise) to net area sown - 18.74%
- Irrigated paddy area to total area - 76.47%
- Cropping intensity - 128.21%

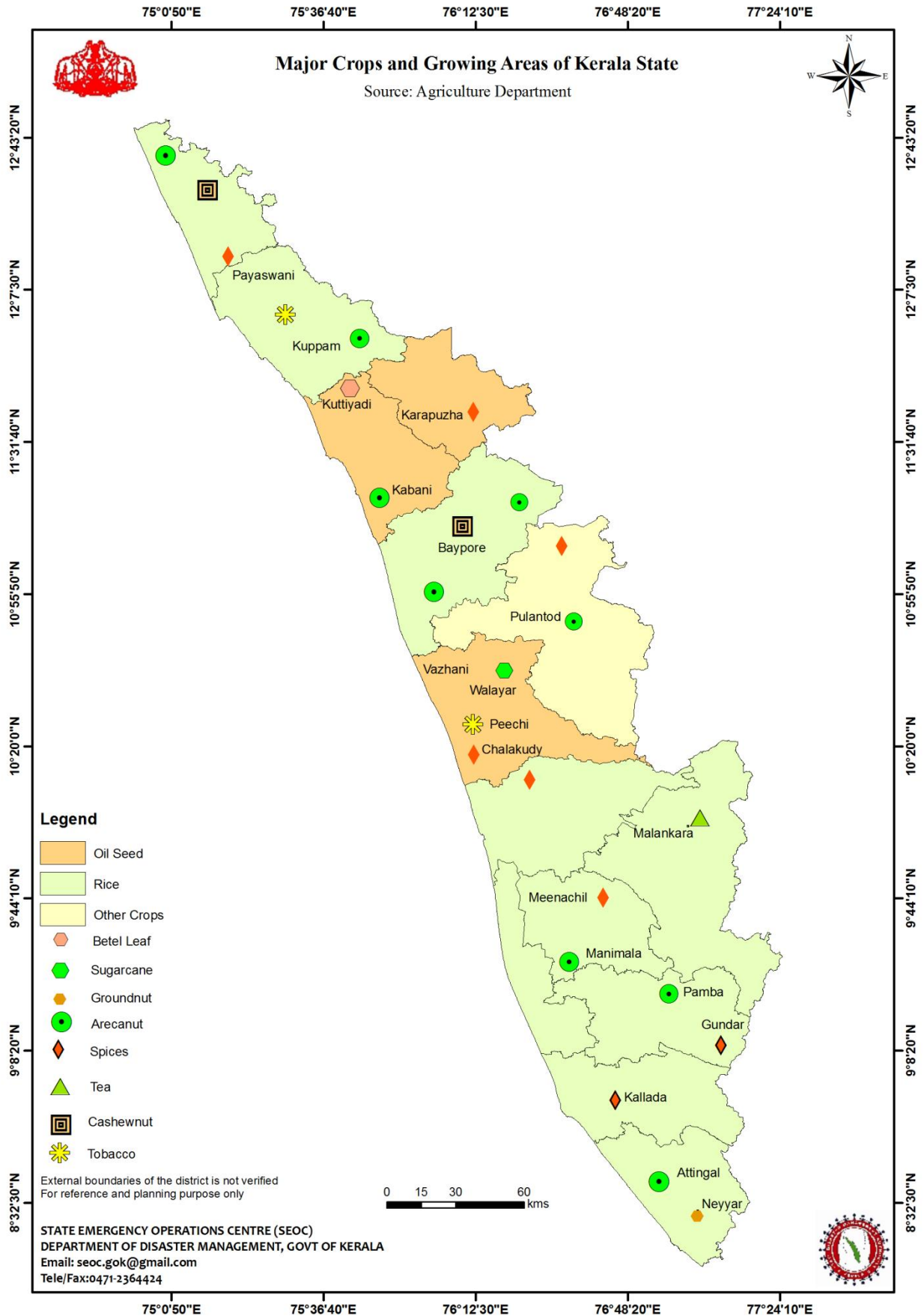
### 2.3.2 Crop wise cumulative area under cultivation

- Paddy - 5214.3 ha
- Pulses - 1,738 ha
- Sugar crops - 3,362.5 ha
- Pepper - 85,207 ha
- Oil Seeds - 7,84,326.6 ha
- Arecanut - 97,696 ha
- Ginger - 5,151 ha
- Cashew - 41,661 ha
- Turmeric - 2,632 ha
- Cardamom - 39,080 ha
- Tamarind - 11,549 ha
- Nutmeg - 22,065 ha
- Rubber - 5,51,050 ha
- Fresh Fruits - 3,27,210 ha
- Vegetables - 46,732 ha

### 2.3.3 Damages to agriculture

The unprecedented heavy rains, storms and floods have caused exorbitant losses to the agriculture sector. Figure 7 shows the distribution of crops in Kerala. The details of district wise crop losses are given in Table 5. It may be noted that in Kerala, majority of the farmers are small and medium farmers. It is only the small and marginal farmers (SMF) who claim for damages via NDRF/SDRF. Hence, loss estimation and claim is made only for the SMF section.

Table 6 shows the cost incurred for desilting and removal of debris. Many polder walls (bunds) that protected below mean sea level farm lands of Alappuzha, Thrissur, Kottayam and Palakkad breached. Permanent repair of polder walls can only be undertaken after the monsoon season. Until then, as a temporary measure, the breached bunds have been repaired using sand bags, the cost of which may be found in Table 7.



**Figure 7: Agriculture scenario of Kerala**



**Table 5: District wise agricultural damages (SMF only)**

District	>33% crop loss extent (ha)	Relief as per norms (in lakhs)
Thiruvananthapuram	1356.96	168.595
Kollam	869.73	108.431
Pathanamthitta	12085.05	984.986
Alappuzha	12095.55	1606.928
Kottayam	7170.71	939.179
Idukki	5745.97	966.176
Ernakulam	1296.66	142.496
Thrissur	3569.25	468.672
Palakkad	6250.43	840.264
Malappuram	5275.4	666.561
Kozhikode	627.04	59.503
Wayanad	1876.80	248.463
Kannur	926.53	126.882
Kasargode	199.29	29.968
<b>Total</b>	<b>59345.37</b>	<b>7357.104</b>

A large number of pump sets have been damaged due to the unpredicted rain. Table 8 shows the cost of repair of pumps that have been used for dewatering. The cost of dewatering the polders that were inundated are given in Table 9.

**Table 6: District wise assistance for land and other losses (Agriculture)**

District	Area (ha)	Relief as per norms (in lakhs)
Thiruvananthapuram@₹12,200/ha	1356.96	165.55
Kollam@₹12,200/ha	869.73	106.11
Pathanamthitta@₹12,200/ha	12085.05	1450.21
Alappuzha@₹12,200/ha	12095.55	1475.66
Kottayam@₹12,200/ha	7170.71	874.83
Idukki@₹37,500/ha	5745.97	2154.74
Ernakulam@₹12,200/ha	1296.66	158.19
Thrissur@₹37,500/ha	3569.25	1338.47
Palakkad@₹37,500/ha	6250.43	2343.91
Malappuram@₹37,500/ha	5275.4	1978.28
Kozhikode@₹37,500/ha	627.04	235.14
Wayanad@₹37,500/ha	1876.80	703.80
Kannur@₹12,200/ha	926.53	113.04
Kasargode@₹12,200/ha	199.29	24.31
<b>Total</b>	<b>59345.37</b>	<b>13122.22</b>

**Table 7: Repair of embankments**

District	Number	Cost incurred@2 lakhs/embankment (in lakhs)
Alappuzha	350	700
Thrissur	100	200
Kottayam	48	96
Pathanamthitta	25	50
<b>Total</b>	<b>523</b>	<b>1046</b>

**Table 8: Repair of pumps – Agriculture dewatering**

District	Number	Cost incurred @20,000/pump (in lakhs)
Alappuzha	802	160.4
Thrissur	50	10
Kottayam	21	4.2
Pathanamthitta	18	3.6
<b>Total</b>	<b>891</b>	<b>178.2</b>

**Table 9: Dewatering – Agricultural land**

District	Number of Polders	Cost incurred @12 lakhs (in lakhs)
Alappuzha	115	1380
Thrissur	5	60
Kottayam	3	36
Pathanamthitta	4	48
<b>Total</b>	<b>127</b>	<b>1524</b>

### 2.3 Debris clearance from public land

The Local Self Government Department has through its various agencies conducted massive cleaning of public assets and community assets.

Government has released funds for cleaning debris affected public land. Every flood notified Grama Panchayath ward is given ₹25,000/- and every affected corporation and municipality ward is given ₹50,000/- for the purpose. Table 10 shows the cost incurred for cleaning debris from public land.

**Table 10: District wise assistance for debris clearance from public land**

District	Number of Urban Wards	Cost @₹50,000	Number of Rural Wards	Cost @₹25,000
Alappuzha	154	77	862	215.5
Ernakulam	288	144	924	231
Kottayam	152	76	422	105.5
Pathanamthitta	83	41.5	426	106.5
Thrissur	287	143.5	1297	324.25
Wayanad	56	28	278	69.5
Idukki	69	34.5	792	198
<b>Total</b>	<b>1089</b>	<b>544.5</b>	<b>5001</b>	<b>1250.25</b>

### 2.4 Housing

One of the major sectors which was impacted severely is Housing. A total of 1,11,356 urban houses in urban areas and 6,92,848 houses in grama panchayaths have been affected by floods in Alappuzha, Ernakulam, Kottayam, Pathanamthitta, Thrissur and Wayanad. District wise details of number of fully and severely damaged houses with estimated loss are given in Table 11:

**Table 11: District wise house damage estimates – Pucca**

Districts	Fully Damaged Houses		Severely Damaged Houses		Total Amount (in Lakhs)
	Number	Amount (in Lakhs)	Number	Amount (in Lakhs)	
Thiruvananthapuram	111	113.1645	2940	2795.94	2909.1
Kollam	95	96.8525	1338	1272.438	1369.3
Pathanamthitta	741	755.4495	32775	31169.03	31924.5
Alappuzha	2075	2115.4625	18990	18059.5	20174.95
Kottayam	76	77.482	656	623.86	701.34
Ernakulam	615	626.9925	1684	1601.5	2228.48
Idukki	1166	1188.737	1445	147.25	1335.98
Thrissur	2889	2945.3355	18241	17347.2	20292.53
Palakkad	1118	1139.801	3604	3427.4	4567.21



Malappuram	500	509.75	3731	3548.18	4057.931
Kozhikode	107	109.0865	1338	1272.44	1381.53
Wayanad	702	715.689	9250	942.6	1658.26
Kannur	121	123.3595	3216	3058.42	3181.78
Kasaragod	3	3.0585	74	70.37	73.43
<b>Total</b>	<b>10319</b>	<b>10520.22</b>	<b>99282</b>	<b>85336.1</b>	<b>95856.3</b>

District wise details of number of partially damaged houses with estimated loss is given in Table 12:

**Table 12: District wise house damage estimates – Partial (Flood hit and cleaned)**

Districts	Number of houses in urban@25000/house	Amount (in Lakhs)	Number of houses in rural@25000/house	Amount (in Lakhs)
Pathanamthitta	11622	2905.5	49768	12442
Alappuzha	15484	3871	171496	42874
Kottayam	16440	4110	69441	17360.25
Ernakulam	36231	9057.75	175415	43853.75
Thrissur	29172	7293	106818	26704.5
Wayanad	2407	601.75	8554	2138.5
<b>Total</b>	<b>1,11,356</b>	<b>27839</b>	<b>5,81,492</b>	<b>145373</b>

## 2.5 Fisheries

Strong winds, rainfall and floods have caused widespread damages to the fisheries sector of the state. Fishing assets such as boats and nets have been destroyed. Houses of fishermen were damaged, beyond repairs. Aquaculture of the state has been adversely affected to a great extent. Many government fishery farms, hatcheries and other assets of the Department of Fisheries such as National Fish Seed Farm and Centre for Fresh water Aquaculture at Neyyar dam and National Institute of Fisheries Administration and Management (NIFAM) at Aluva were badly affected. Moreover, alternative livelihood flagship activities aimed at the fishermen community (such as Theeramythri programme that impacts the fishermen women) have also been badly hit.

As many as 235 boats were fully damaged. Ernakulam district, where 96 boats have been damaged, leads the list. Out of the 1002 boats that have been partially damaged, 818 boats have solely been in Kottayam district. A total of 1748 nets have been fully damaged while 1620 nets have been partially damaged in Kerala. Financial loss due to fully damaged nets is Rs. 45,44,800 whereas the loss due to the partially damaged nets is ₹34,02,000. Kottayam district suffered the highest loss due to damage of nets as 739 nets have been fully damaged and 965 nets have been partially damaged in the district. As far as damage to fish farms are concerned, a whopping 12,452.2 hectares worth ₹10,21,08040 have been affected due the calamity. Palakkad district tops the list for the same as 4608.63 hectares of farms worth ₹3,77,90,766 have been affected in the district. The details of district wise damages are given below in Table 13 and Table 14.

**Table 13: Damage to fisheries sector**

District	Fully Damaged Boat	Partially Damage Boat	Fully Damaged Net	Partially damaged Net	Total
Thiruvananthapuram	4	2	3	1	0.565
Kollam	15	7	74	1	3.672
Pathanamthitta	34	24	228	20	10.596
Alappuzha	22	13	167	1	7.008
Kottayam	5	818	739	965	73.497
Idukki	23	7	76	3	4.534
Ernakulam	96	63	213	346	24.603
Thrissur	18	17	132	276	11.653
Palakkad	0	4	71	2	2.052
Malappuram	12	6	8	4	1.69
Kozhikode	4	9	36	0	1.689
Wayanad	0	0	0	0	0
Kannur	2	32	1	1	1.551
Kasargod	0	0	0	0	0
<b>Total</b>	<b>235</b>	<b>1002</b>	<b>1748</b>	<b>1620</b>	<b>143.11</b>

**Table 14: Desilting/repair/restoration of fish farms**

District	Area (ha)	Cost (in lakhs)
Thiruvananthapuram	17.68	1.4498
Kollam	98.88	8.1082
Pathanamthitta	11.79	0.9668
Alappuzha	1319.89	108.23
Kottayam	1030.63	84.512
Idukki	26.07	2.1377
Ernakulam	351.04	28.785
Thrissur	4473	366.79
Palakkad	4608.63	377.91
Malappuram	53.82	4.4132
Kozhikode	105.35	8.6387
Wayanad	334.51	27.43
Kannur	18.91	1.5506
Kasargod	2	0.164
<b>Total</b>	<b>12452.2 ha</b>	<b>1021.1</b>

## 2.6 Animal Husbandry

The calamity has also affected the Animal Husbandry sector. The unprecedented rainfall which triggered flooding in the state has resulted in the death of large number of cattle, buffaloes, goats and poultry. Further, destruction of cattle sheds, shortage of fodder, veterinary medicines and vaccines added to the plight.

Alappuzha is the worst affected district with regard to this sector, a total of 7146 cattles died, which includes 650 cows and buffalo, 2994 sheep and 3502 calves. Around 500792 poultry died in these flash floods. The details of item wise damages are given in Table 15.

**Table 15: District wise damages to animal husbandry and dairy development sector**

Item	Loss in lakhs
Animal & Poultry fatality	3898.733
Totally damaged cattle sheds	244.688
Provision for feed and concentrate	504.12309
Transportation of fodder	0.44
Additional Cost of Medicines and Vaccines	5.84
<b>Total</b>	<b>4653.824</b>

The flood has resulted in the death of 40188 large animals, 7765 small animals and 799256 birds. The state has scientifically buried these carcasses. This has incurred substantial cost to the state, roughly @₹5000 per large animal, ₹1000 per small animal and ₹30 per bird, on an average. Depending on the terrain and proximity to dry land, the cost may be lesser or more (Table 16).

**Table 16: District wise number of carcasses disposed**

District	Large animals	Small animals	Birds	Expense (in lakhs)
Alappuzha	664	2371	90415	84.03
Ernakulam	2689	2453	149286	203.76
Kottayam	137	471	61258	29.94
Pathanamthitta	107	86	72104	27.84
Thrissur	1832	2247	374921	226.55
Wayanad	34759	137	3319	1740.32
<b>Total</b>	<b>40,188</b>	<b>7765</b>	<b>7,51,303</b>	<b>2313.44</b>

## 2.7 Power

The unprecedented rainfall which triggered flooding in the state has resulted in heavy loss to Power Sector. All three activity divisions viz. Generation, Transmission and Distribution Wings suffered heavy loss. Table 17 shows the cost incurred for repair of the power sector.

Five major Hydro Stations were impacted and 7 small hydro-electric power projects in the State. The Damage in the transmission wing includes 50 Substations. 22 Stations got submerged, control Systems got damaged, 10 Power Transformers were inundated and 10 Major Transmission Corridors were interrupted. In Distribution Sector around 284 Electrical Sections in Six Districts were impacted, around 1000 Distribution Transformers submerged, 3500 km Distribution lines were destroyed, 30,000 electric poles damaged, 5 lakhs single phase and 1 lakh three phase energy meters were damaged.

**Table 17: Cost incurred for repair of power sector**

District	Cost (In lakhs)
Thiruvananthapuram	181.18
Kollam	170.41
Pathanamthitta	1496.67
Alappuzha	130.05
Kottayam	83.57
Idukki	188.37
Ernakulam	4251.58
Thrissur	1552.62
Palakkad	100.16
Malappuram	110.73

Kozhikode	65.57
Wayanad	51.59
Kannur	84.68
Kasaragode	35.93
<b>Total</b>	<b>8503.11</b>

## 2.8 Public Works Department

Due to the extremely devastating monsoon calamity in the form floods and landslides, Public Works Department (PWD) has suffered unprecedented losses as evidenced by damage to physical infrastructure especially roads and bridges. All types of roads and bridges have been negatively affected. Some roads and bridges have even been completely washed away due to floods. Culverts have also been severely damaged.

A total of 9538.45 kilometres of roads have been damaged in Kerala. At one lakh rupees per kilometre, a colossal amount of ₹95,38,45,000 would be required to immediately restore the damages. Idukki is the worst hit district in this context as 2,130 kilometres of roads have been damaged in the district, followed closely behind by Ernakulam where 2,105 kilometres of roads have been damaged. Moving on, as many as 510 bridges have been damaged due to the calamity. Around 5,10,00,000 rupees would be required for rectifying the damages to bridges. The highest number of bridges damaged has been in Alappuzha, as 121 bridges have been damaged in the district. Table 18 and Table 19 shows the cost incurred for immediate restoration of roads and bridges.

**Table 18: Cost incurred for restoration of roads**

District	Length (Km)	Cost (in lakhs)
Thiruvananthapuram	475	475
Kollam	340	340
Pathanamthitta	550	550
Alappuzha	241	241
Kottayam	291	291
Ernakulam	2105	2105
Idukki	2130	2130
Thrissur	598	598
Palakkad	164	164
Malappuram	1231	1231
Kozhikode	332	332
Wayanad	565	565
Kannur	100	100
Kasargode	416.45	416.45
<b>Total</b>	<b>9538.45</b>	<b>9538.45</b>

**Table 19: Cost incurred for restoration of bridges**

District	No. of Bridges affected	Cost (in lakhs)
Thiruvananthapuram	5	5
Kollam	48	48
Pathanamthitta	68	68
Idukki	56	56
Kottayam	6	6

Alappuzha	121	121
Ernakulam	13	13
Thrissur	41	41
Palakkad	78	78
Malapuram	18	18
Kozhikode	8	8
Wayanad	9	9
Kannur	20	20
Kasargode	19	19
<b>Total</b>	<b>510</b>	<b>510</b>

## 2.9 Irrigation and Water Sector

The entire water supply system got totally disrupted due to the flood. The Kerala Water Authority and Irrigation departments run a large network of water supply for drinking as well as for irrigation purposes. Both of these sectors had a broad network of pipelines and canal systems which were passing through the urban and rural areas in Kerala. Irrigation canals, Public Taps, Pipelines, Pump houses, check dams, Bunds, Irrigation Pumps and other irrigation machineries and structures got damaged due to Floods, landslides and landslips. Most of the engineering structures washed away by huge landslides and inundated by flooding. Huge losses in machineries, equipments, structural and non-structural assets have been estimated by the concerned authorities. The highest loss reported in the water supply sector is in the Thrissur and Pathanamthitta district is the highest in irrigation sector which may be noted from Table 20.

**Table 20: Cost incurred for immediate restoration of irrigation and water sector**

District	Irrigation sector - Cost (in lakhs)	Water Supply sector – Cost (in lakhs)	Total
Thiruvananthapuram	745.45	66	811.45
Kollam	1149.50	58.5	1208
Pathanamthitta	11234.15	157.5	11391.65
Alappuzha	3276	136.5	3412.5
Kottayam	1484.50	165	1649.5
Idukki	4182.50	82.5	4265
Ernakulam	5123.50	621	5744.5
Thrissur	8924.51	696	9620.51
Palakkad	5300.90	124.5	5425.4
Malappuram	3370.00	139.5	3509.5
Kozhikode	2342.20	39	2381.2
Wayanad	1674.78	45	1719.78
Kannur	1985.00	12	1997
Kasargode	466.80	0	466.8
<b>Total</b>	<b>51259.79</b>	<b>2343</b>	<b>53602.79</b>

## 2.10 Gratuitous relief

Within the provisions of the State Disaster Response Fund, the Government extended gratuitous relief to the affected community. People were housed in camps and outside the camps

with relatives and in foster homes. Government supported them with relief assistance and sustenance. Drinking water supply was also undertaken to these camps.

**Table 21: Cost incurred for running relief camps**

District	Total Number of Camps	Total Number of inmates in Government run camps	Total Cost (in Lakhs)
Thiruvananthapuram	94	8662	8.04951
Kollam	168	21550	4.8173
Pathanamthitta	4352	807911	1615.822
Alappuzha	2126	736316	404.9738
Kottayam	788	249085	376.6
Idukki	363	55489	34.90766
Ernakulam	1582	846419	3554.96
Thrissur	1513	514366	500.1995
Palakkad	165	16684	200
Malappuram	213	42099	35.69233
Kozhikode	399	53636	58.0965
Wayanad	451	60847	639.5
Kannur	37	2498	0.25110
Kasargod	2	375	0.20000
<b>Total</b>	<b>12253</b>	<b>3415937</b>	<b>7434.0697</b>

**Table 22: Cost incurred for supply of drinking water to relief camps**

District	Total Number Tankers/Boats	Total Number of Trips	Total cost (in Lakhs)
Kollam	66	210	0.5556
Pathanamthitta	37	1584	8.05
Alappuzha	182	470	18.75
Kottayam	8	35	4.872
Ernakulam	490	964	337.40
Palakkad	20	54	NA
Malappuram	2	11	0.12
<b>Total</b>	<b>805</b>	<b>3328</b>	<b>369.7476</b>

**Table 23: Cost of immediate assistance for loss of utensils and clothes**

District	Total Number families	Total Cost incurred (in Lakhs)
Thiruvananthapuram	2761	104.92
Kollam	4983	185.93
Alappuzha	1,22,058	4638.2
Kottayam	75,870	2883.06
Pathanamthitta	45,283	1720.75
Idukki	3284	124.79
Ernakulam	1,68,298	6395.32
Thrissur	1,17,035	4447.33
Palakkad	7420	281.96
Wayanad	7328	278.46
Malappuram	34877	1325.33
Kozhikode	16,327	620.43
Kannur	151	5.74
Kasargod	0	0
<b>Total</b>	<b>6,05,675</b>	<b>23015.65</b>

The State Government mobilised the following national forces - NDRF: 58 teams, 207 boats; Army: 23 columns, 104 baults; Navy – 94 rescue teams, 1 medical team, 9 helicopters, 2 fixed

wing aircrafts and 94 boats; Coast Guard – 36 teams, 49 boats, 2 helicopters, 2 fixed wing and 27 hired boats; Air Force: 22 helicopters from Air Force and 23 fixed wing aircrafts; Border Security Force: One company; CRPF: 10 teams; BSF: 2 companies and 1 water vehicle team.

The cost of search and rescue incurred from SDRF may be paid in actuals as given below. Further, the fuel bills of India Air Force may be paid from NDRF directly.

**Table 24: Cost of Search and Rescue**

District	Total cost (in lakhs)
Thiruvananthapuram	100
Kollam	50
Pathanamthitta	2500
Alappuzha	4000
Kottayam	1000
Idukki	5000
Ernakulam	6000
Thrissur	5000
Palakkad	200
Malappuram	100
Kozhikode	150
Wayanad	1000
Kannur	2000
Kasargod	0
<b>Total</b>	<b>27100</b>

## 2.11 Search and Rescue by Fishermen

Fishermen of the State rendered phenomenal voluntary assistance towards search and rescue in the flood affected areas. As many as 669 boats went out with 4537 fishermen, and they would have saved at least 65,000 lives. The cost of sending these fishermen boats to the flood affected areas, fuel and the cost of repair of the boats that were damaged during the rescue operations were paid by the Government.

**Table 25: Cost of Search and Rescue by Fishermen**

District	Total number of boats	Cost incurred @ ₹50,000/boat
Thiruvananthapuram	113	56.5
Kollam	165	82.5
Pathanamthitta	2	1
Alappuzha	118	59
Kottayam	15	7.5
Ernakulam	127	63.5
Thrissur	31	15.5
Palakkad	6	3
Malappuram	25	12.5
Kozhikode	25	12.5
Kannur	42	21
<b>Total</b>	<b>669</b>	<b>334.5</b>

## 2.12 Law and order sector

Torrential rains and the deluge thereafter have resulted in structural damages of many public buildings/structures either fully or partially in the state. Immediate repair and retrofitting will be needed to make these offices fully functional.

Out of the 14 districts, 10 districts reported of damages in police buildings. Across the state, a total of 69 police stations and 18 offices of the department got damaged in this calamity. Alappuzha district has got the highest number of damaged buildings in the state.

**Table 26: Cost incurred in the law and order sector**

District	Number of Damaged Stations	Amount claimed @ 2 lakh/building
Alappuzha	19	38
Kottayam	14	28
Pathanamthitta	9	14
Idukki	2	4
Ernakulam	10	20
Thrissur	5	10
Palakkad	2	4
Wayanad	9	18
Malappuram	2	4
Kozhikode	15	30
<b>Total</b>	<b>87</b>	<b>174</b>

## 2.13 Community Owned Assets

In Kerala, majority of people depend on open wells for household drinking water needs. Many of these wells have been damaged. These drinking water structures needs to be immediately restored for which an amount of ₹10,000/- is paid per well (Table 27). Heavy losses were incurred to the roads, bridges, community owned wells etc. The flood waters gushed through the roads, making them severely unfit for passage. These roads need to be built better to be used with immediate effect. At many places, the rivers breached the banks depositing huge amounts of silt. The fact that many areas in rural Kerala still entirely depends on well water for the basic needs required immediate restoration of the wells. The overflowing of canals resulted in flooding of several localities and hence the bunds had to be restored and reinforced. The tables below shows the loss incurred to the community owned assets such as length of village roads, anganwadis, CHCs, PHCs, schools etc. (Table 29, Table 30, Table 31).

**Table 27: Cost incurred for repair and restoration of community owned drinking water structures**

District	Number of Damaged Structures	Amount claimed @ ₹10000/well
Alappuzha	58611	5861.1
Ernakulam	78209	7820.9
Kottayam	44154	4415.4
Pathanamthitta	42406	4240.6
Thrissur	89635	8963.5
Wayanad	3988	398.8
<b>Total</b>	<b>317003</b>	<b>31700.3</b>



## 2.14 Artisans

One of the major impacts of floods was felt in Chendamangalam where weavers weave a special kind of cotton cloth which has a Geo-indication tag. Around 2000 weavers in Chendamangalam were looking at the Onam season this year with a lot of hope as it is their busiest time. However, when the floodwaters of the Periyar seeped into their homes, showrooms, dyeing units and factories in August, those hopes were washed away. For an already-dying craft, struggling with mechanised textile industries, the floods are threatening to be a final nail in the coffin. The combined losses of the handloom industry in Chendamangalam are estimated at ₹15 crores.

**Table 28: Cost incurred for Handicrafts/Handloom – Assistance to Artisans**

<b>District</b>	<b>Replacement of damaged tools @₹4100/unit to 1000</b>	<b>Loss of raw materials@₹4100/unit to1700</b>
Ernakulam	41	69.70

**Table 29: Cost Incurred for immediate restoration of community owned infrastructure (Grama Panchayath, Block Panchayath & District Panchayth)**

<b>Damaged Community Assets - District (ZP), Block Panchayath (BP) &amp; Grama Panchayath (GP)</b>										
<b>District</b>	<b>No.of Schools</b>	<b>Amount Claimed @ 2 lakh /school</b>	<b>No. of Anganawadis</b>	<b>Amount claimed @ 2 lakh/anganwadi</b>	<b>No.of Primary Health Centres</b>	<b>Amount Claimed @ 2 lakh/PHC</b>	<b>No.of Panchayat owned buildings</b>	<b>Amount claimed @ 2 lakh/building</b>	<b>LSG Roads (KM)</b>	<b>Amount Claimed @0.6 lakh/km</b>
Thiruvananthapuram	6	12	13	26	2	4	3	6	411	247
Kollam	28	56	28	56	8	16	5	10	478	287
Pathanamthitta	46	92	39	78	4	8	35	70	1024	614
Alappuzha	90	180	135	270	42	84	79	158	838	503
Kottayam	33	66	55	110	4	8	8	16	631	379
Idukki	37	74	47	94	20	40	19	38	79.6	48
Ernakulam	56	112	178	356	22	44	50	100	1502	901
Thrissur	15	30	157	314	15	30	26	52	712	427
Palakad	26	52	88	176	22	44	28	56	1859	1115
Malapuram	24	48	56	112	27	54	19	38	2002	1201
Kozhikode	7	14	31	62	7	14	12	24	654	392
Wayanad	35	70	78	156	6	12	39	78	910	546
Kannur	9	18	18	36	6	12	6	12	913	548
Kasargoade	4	8	4	8	3	6	1	2	222	133
<b>TOTAL</b>	<b>416</b>	<b>832</b>	<b>927</b>	<b>1854</b>	<b>188</b>	<b>376</b>	<b>330</b>	<b>660</b>	<b>12235.6</b>	<b>7341.36</b>

**Table 30: Cost Incurred for immediate restoration of community owned infrastructure (Municipality)**

<b>Damaged Community Assets - Municipality</b>										
<b>District</b>	<b>No. of Schools</b>	<b>Amount claimed @2 lakh/school</b>	<b>No. of Anganawadis</b>	<b>Amount claimed @2 lakh/anganwadi</b>	<b>No. of Primary Health Centres</b>	<b>Amount claimed @2 lakh/PHC</b>	<b>No. of Municipality owned buildings</b>	<b>Amount claimed @2 lakh/building</b>	<b>LSG Roads (km)</b>	<b>Amount claimed @0.6 lakh/km</b>
Thiruvananthapuram	1	2	7	14	-	-	-	-	34.8	21
Kollam	2	4	2	4	-	-	3	6	76.5	46
Pathanamthitta	2	4	7	14	1	2	16	32	246.8	148
Alappuzha	19	38	34	68	2	4	7	14	81.58	49
Kottayam	3	6	11	22	1	2	3	6	259.435	156
Idukki	1	2	5	10	-	-	2	4	194.95	117
Ernakulam	13	26	36	72	3	6	11	22	282.02	169
Thrissur	7	14	44	88	4	8	16	32	204.357	123
Palakkad	7	14	6	12	3	6	18	36	348.79	209
Malappuram	3	6	17	34	5	10	3	6	344.663	207
Kozhikode	1	2	4	8	2	4	6	12	89.145	53
Wayanad	2	4	4	8	1	2	2	4	165.365	99
Kannur	1	2	1	2	3	6	1	2	184	110
Kasargode	1	2	2	4	-	-	-	-	11.7	7
<b>Total</b>	<b>63</b>	<b>126</b>	<b>180</b>	<b>360</b>	<b>25</b>	<b>50</b>	<b>88</b>	<b>176</b>	<b>2524.105</b>	<b>1514.5</b>

**Table 31: Cost Incurred for immediate restoration of community owned infrastructure (Corporation)**

<b>Damaged Community Assets - Corporation</b>										
<b>District</b>	<b>No. of Schools</b>	<b>Amount claimed @2 lakh/school</b>	<b>No. of Anganawadis</b>	<b>Amount claimed @ 2 lakh/anganwadi</b>	<b>No. of Primary Health Centres</b>	<b>Amount claimed @2 lakh/PHC</b>	<b>No. of Corporation owned buildings</b>	<b>Amount claimed @2 lakh/building</b>	<b>LSG Roads (km)</b>	<b>Amount claimed @0.6 lakh/km</b>
Trivandrum	9	18	24	48	3	6	-	-	250	150.00
Kollam	-	-	-	-	-	-	2	4	69.12	57.67
Kochi	-	-	1	2	-	-	-	-	68.99	41.39
Thrissur	3	6	2	4	-	-	1	2	94.39	56.63
Kozhikode	4	8	17	34	1	2	3	6	103	61.8
Kannur	-	-	-	-	-	-	-	-	14.419	8.65
<b>Total</b>	<b>16</b>	<b>32</b>	<b>44</b>	<b>88</b>	<b>4</b>	<b>8</b>	<b>6</b>	<b>12</b>	<b>626.919</b>	<b>376.15</b>

### **3. Additional requests**

- The calamity is a second consequent calamity in the same season affecting the same community and hence additional assistance may be calculated accordingly
- The period of calamity relief and response may be extended beyond 30 days and may be made co-terminus with the closing of the last relief camp housing the flood affected

## Abstract of claims

SL. NO	ITEMS	RATE/UNIT	TOTAL UNITS	CLAIMS (IN LAKHS)
1	2	3	4	6
1	<b>GRATUITOUS RELIEF</b>			
	a) Ex-Gratia payment to families of deceased persons - Table 4	400000	339	1356.00
2	<b>SEARCH &amp; RESCUE OPERATIONS</b>			
	(a) Cost of search and rescue measures/evacuation of people affected/likely to be affected (as per actual) - Table 24			27100
	(b) Search and rescue by fishermen volunteers - Table 25	50000	669	334.50
3	<b>RELIEF MEASURES</b>			
	a) Temporary accommodation - Running Relief Camps - Table 21, Table 22			7434
	b) Clothing and utensiles - Table 23	3800	605675	23016
	c) Emergency supply of drinking water in rural areas and urban areas (as per actual) - Table 22			370
4	<b>CLEARANCE OF AFFECTED AREAS</b>			
	a) Clearance of debris in public areas as per actual within 30 days from the date of start of work (as per actual) - Table 10			1795
	b) Draining off flood water in affected areas as per actual within 30 days from the date of start of work (as per actual) - Table 9	1200000	127	1524
	c) Disposal of carcasses (as per actual) - Table 16			2313
5	<b>AGRICULTURE</b>			
(i)	<b>Assistance farmers having landholding upto 2 ha</b>			
A	<b>Assistance for land and other loss</b>			
	a) De-silting of agricultural land - Table 6			13122.22
	c) Restoration/Repair of fish farms - Table 14			1021.00

B	<b>Input subsidy (where crop loss is 33% and above) - Table 5</b>			7357.10
6	<b>ANIMAL HUSBANDRY - ASSISTANCE TO SMALL AND MARGINAL FARMERS - Table 15</b>			
	Animal and poultry fatality			3898.73
	Provision of feed & concentrate			504.00
	Additional cost of medicines and vaccines			5.84
	Transportation of fodder			0.44
7	<b>FISHERY</b>			
	Damage to fisheries sector - boats and nets - Table 13			143.11
8	<b>HANDICRAFTS/HANDLOOM – ASSISTANCE TO ARTISANS - Table 28</b>			
	i) For replacement of damaged tools/equipment	4100	1000.00	41.00
	ii) For loss of raw material/goods in process/finished goods	4100	1700.00	69.70
9	<b>HOUSING</b>			
	(a) Fully damaged/destroyed houses - Table 11			10520.22
	(b) Severely damaged houses - Table 11			85336
	(c) Partially Damaged Houses - Table 12			173212
	(e) Cattle sheds - Table 15			244.69
10	<b>INFRASTRUCTURE</b>			
	a) Roads @ 1 lakh/km for State Highway and Major Roads - Table 18	100000	9538	9538.45
	b) Bridges (PWD) @ 1 lakh/km - Table 19	100000	510	510
	c) Electricity - Table 17			8503
	d) Irrigation - Table 20			53603
	e) Open Wells - drinking water structures - Table 27	10000	317003	31700.30
	f) Repair of pumpsets - Table 29	20000	891	178.20
	g) Panchayath Schools - Table 29	200000	416	832.00
	h) Panchayath Anganawadis - Table 29	200000	927	1854.00
	i) Panchayath Primary Health Centres - Table 29	200000	188	376.00

	j) Panchayath owned buildings - Table 29	200000	330	660.00
	k) Panchayath Roads - Table 29	60000	12236	7341.60
	l) Municipality School - Table 30	20000	63	12.60
	m) Municipality Anganawadis - Table 30	200000	180	360.00
	n) Municipality Primary Health Centres - Table 30	200000	25	50.00
	o) Municipality owned buildings - Table 30	200000	88	176.00
	p) Municipality Roads - Table 30	60000	2524	1514.46
	q) Corporation School - Table 31	20000	16	3.20
	r) Corporation Anganawadis - Table 31	200000	44	88.00
	s) Corporation Primary Health Centres - Table 31	200000	4	8.00
	t) Corporation owned buildings - Table 31	200000	6	12.00
	u) Corporation Roads - Table 31	60000	627	376.15
	v) Law and order buildings - Table 26	200000	87	174.00
	w) Repair of embankments - Table 7	200000	523	1046.00
			<b>Total</b>	<b>479635</b>
<b>Four thousand seven hundred and ninety six crore thirty five lakhs</b>				

**Sd/-**  
**P.H Kurian**  
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